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STABILITY OF SINGLE AND THREE-WAY CROSS HYBRIDS OF COTTON FOR LINT YIELD

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ABSTRACT

Of the 34 cotton hybrids evaluated in five environments, JKHy-1 was the most adaptable, as it had the highest average performance, near unit regression (0.840), and least deviations from regression. It was released for commercial cultivation in Madhya Pradesh in 1976.

Key words: Stability, hybrids, cotton.

Fluctuations in the production of cotton are mainly due to sensitivity of the crop to environments and, therefore, there is need to identify and/or evolve hybrids which give stable performance over different environments. Finlay and Wilkinson [1] and Eberhart and Russell [2] suggested methods to screen genotypes for stability.

In the present investigation, 34 hybrids (9 single crosses, 21 three-way crosses, and four checks) have been evaluated in five environments to study genotype × environment interactions and phenotypic stability of different cotton hybrids.

MATERIALS AND METHODS

The 34 cotton hybrid populations comprising 30 hybrids (21 three-way and 9 single crosses) and four commercial hybrids as checks (JKHy-1, JCHB-12, Varalaxmi and Hybrid-4) were planted in randomized block design with three replications in 1985 in each of the five environments, namely, low (60 : 30 : 15 kg NPK/ha) and high (100 : 50 : 25 NPK/ha) fertility levels under rainfed conditions at Indore, low fertility with rainfed cultivation at Khandwa, and high fertility combined with irrigated condition at Khandwa and Ujjain. Data recorded for lint yield/plant on five competitive plants in each treatment were analysed following Eberhart and Russell [2].

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RESULTS AND DISCUSSION

The pooled analysis of variance showed that there were highly significant differencs among the 34 cotton hybrids for lint yield (Table 1) over five environments, indicating that the experimental hybrids were genetically diverse with respect to lint yield. Variances due to environment and genotype × environment (G × E) interactions were significant. Mean square for environment (linear) was also highly significant.

Table 1. Pooled analysis of variance for different components of variation

Source	d.f.	MS	Tested against G×EMS	Tested against pooled deviation MS	Tested against pooled error MS
Genotypes (G)	33	291.9	14.8**	10.0**	65.5**
Environments (E)	4	2851.2	144.3**	97.6**	640.3**
G × E	132	19.8	—	0.7	4.4**
Environment (linear)	1	11404.6	—	390.5**	2561.1**
G × E(linear)	33	56.6	—	1.9**	12.7**
Pooled deviation	102	29.2	—	—	6.6**
Pooled error	330	4.4	—	—	—

**Significant at 1% level.

Mean square for pooled deviations was highly significant, which suggests that variation in the performance of 34 cotton genotypes over five environments was caused by unpredictable factors. This confirms the earlier results [3–7]. It appeared that high fertility and irrigated conditions at Khandwa are the most favourable environment for expression of this character (Table 2). The signs of environmental indices were negative for Indore (all conditions), low fertility–rainfed at Khandwa and high fertility–irrigated at Ujjain, hence these environments are poor for the manifestation of lint productivity of cotton.

Table 2. Values of environmental indices for lint yield

Description of environment	Environmental index
Indore, low fertility — rainfed	− 7.481
Indore, high fertility — rainfed	− 2.393
Khandwa, low fertility — rainfed	− 4.835
Khandwa, high fertility — irrigated	15.798
Ujjain, high fertility — irrigated	−2.228

A genotype is considered to be stable in performance if it has high mean performance, unit regression coefficient (bi= 1) and least deviation from regression (S^2di). When these parameters were studied for each genotype separately, the highest mean yield ($\bar{x}$ = 45.80 g) was recorded in the single-cross check hybrid JKHy-1, followed by three-way hybrids ICHB-8 ($\bar{x}$ = 35.73 g), ICHB-7 ($\bar{x}$ = 34.01 g), and ICHB-3 ($\bar{x}$ = 31.45 g). Only one single-cross hybrid, ICHB-6 ($\bar{x}$ = 33.21 g), recorded higher seed cotton yield. These eight hybrids were preferred to other genotypes for further testing of their stability by regression coefficient (bi) on environments (Table 3). The value of 1.0 for bi indicates average response. The test hybrid JKHy-1

Table 3. Estimates of mean yield ($\bar{x}$), regression coefficient (bi) and deviation from regression (S^2di) for lint yield

Genotype	Lint yield/plant		
	$\bar{x}$	bi	S^2di
ICHB-1	29.27	0.375	43.474**
ICHB-2	31.67	0.392*	5.247
ICHB-3	31.45	0.287*	11.628*
ICHB-4	31.71	0.428	6.916
ICHB-5	30.49	0.492	9.576*
ICHB-6	33.21	0.713	19.360**
ICHB-7	34.01	0.312*	5.362
ICHB-8	35.73	0.843	33.025**
ICHB-9	31.49	0.407	18.283**
ICHB-10	26.28	0.845	6.280
JCHB-12	27.69	1.013	10.567*
Varalaxmi	30.23	1.012	9.696*
ICH-11	13.49	0.732	25.202**
ICH-12	18.12	1.191	42.818**
ICH-13	15.37	1.267	16.589**
ICH-14	20.50	0.814	−2.178
ICH-15	26.78	1.350	31.585**
ICH-16	27.68	1.225	25.654**
ICH-17	28.05	1.420	28.805**
ICH-18	23.76	1.256	78.331**
ICH-19	21.77	1.053	81.885**
ICH-20	19.67	1.164	18.104**
ICH-21	10.15	0.707*	−2.920
ICH-22	16.62	0.902	31.904**
ICH-23	15.56	1.823	24.642**
ICH-24	19.71	1.761	64.185**
ICH-25	16.15	1.326	21.382**
ICH-26	21.76	1.927*	15.355**
ICH-27	18.38	1.115	23.131**
ICH-28	26.01	1.367	40.420**
ICH-29	17.16	1.513	7.919*
ICH-30	22.20	1.140	64.241**
JKHy-1	45.80	0.840	6.786
Hyb-4	27.07	0.900	17.891*

*, **Significant at 5% and 1% levels, respectively.

(0.840) and one three-way cross hybrid, ICHB-8 (0.843), were characterized as medium responsive (bi $\approx$ 1). The group of hybrids with below average response (bi $<$ 1.0) for lint yield includes six three-way hybrids: ICHB-7, ICHB-6, ICHB-4, ICHB-2, ICHB-9 and ICHB-3; and one single cross hybrid; ICHB-6. The remaining three single-cross check hybrids, namely, Hybrid-4 (bi = 0.900), Varalaxmi (bi = 1.012), and JCHB-12 (bi = 1.013), though recorded low lint yield, showed average response. To further isolate a more stable hybrid, another stability parameter, the deviation from regression (S^2di), was used. The lesser the magnitude of S^2di, the greater the stability. By this standard, two three-way hybrids, ICHB-7 (S^2di = 5.362) and ICHB-4 (S^2di = 6.910), and one single-cross check hybrid, JKHy-1 (S^2di = 6.786), possess comparatively higher phenotypic stability. Thus, JKHy-1 with high lint yield, average response, and lower magnitude of S^2di could be considered as the most stable and promising cotton hybrid for Madhya Pradesh. This hybrid was released for commercial cultivation in 1976.

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